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The Vegetation at Sandy Point, Westernport Bay, Victoria

By John Robin* and R. F. Parsons*

Abstract: The fire and clearing history, vegetation and soils of coastal sands at Sandy Point Naval Reserve, one of the last remaining sizeable areas of native coastal vegetation near Melbourne, are described. The major communities are dominated by *Leptospermum laevigatum*, *Banksia integrifolia* and *Eucalyptus viminalis*. The distribution of these in relation to a variety of coastal sand soils and other factors is discussed. The important effects of fire and clearing on the vegetation are stressed.

INTRODUCTION

Sandy Point Naval Reserve (Fig. 1) is currently regarded as a 'unique virgin area' and one of the last sizeable areas of native coastal sand dune vegetation left near Melbourne (Champion 1974), containing 890 ha of native vegetation (Seddon 1974). As such, it is likely to be used increasingly for research on its plant and animal communities, which are presumed to be representative of those formerly widespread on coastal sands around the Melbourne area. In fact, it has already been used in a broad-scale study of the native vegetation of the Mornington Peninsula (Calder 1972), to prepare a key to native vegetation types near Melbourne (Calder, in preparation) and to study mammals (Ahern 1974) and birds (Davis & Reid 1974).

The aim of the present study is to document to what extent the area is undisturbed and to describe the present vegetation both as essential background to more detailed studies and because Victorian coastal vegetation is very poorly known or understood (the only detailed studies being those of Parsons (1966) and Turner, Carr and Bird (1962)). The study is particularly desirable because the area is unusually suitable geologically for critical studies of succession on coastal sands, as will be seen later.

The field work was carried out throughout 1974. Nomenclature for soils, vegetation forms and plant species follows Northcote (1971), Specht (1970) and Willis (1970, 1972) respectively, except where otherwise noted. A set of voucher specimens of all vascular plant species is lodged at La Trobe University Botany Department Herbarium.

CLIMATE

Rainfall data from a coastal site (Somers) about 4 km west of the study area show a mean annual rainfall of 79 cm with a winter maximum. For temperature, mean monthly minima range from about 5·5°C in July to 12·5°C in January, and maxima from 12·5°C in July to 24°C in January (see Australia: Bureau of Meteorology, 1968 for these and other climatic data).

GEOLOGY

The study was restricted to sands of Pleisto-

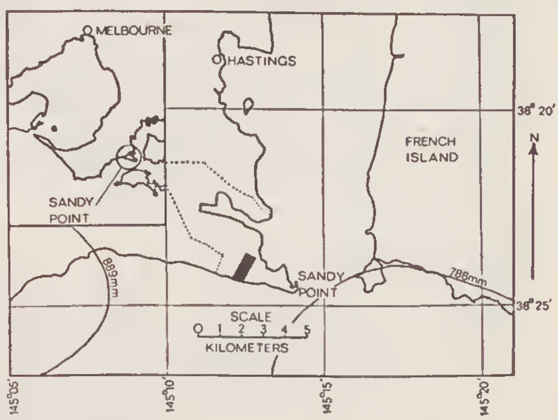

Fig. 1—Location of study area (blacked in), showing mean annual rainfall isohyets (mm). Dashed line shows boundary of Sandy Point Naval Reserve.

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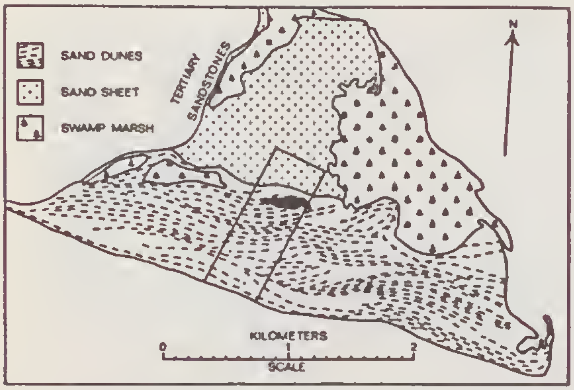

Fig. 2—Geology of Sandy Point after Jenkin (1962) and Victoria: Geological Survey (1967). Dune area and sand sheet both Pleistocene to Recent age, swamps and marshes include mangroves, salt marsh and fresh-water swamps. Area studied in detail shown by rectangle. Blacked in area shows low-lying sand area with *Poa* grassland mentioned in Appendix 1.

cene to Recent age (Fig. 2; Victoria, Geological Survey, 1967). For completeness, the sand areas both in the Naval Reserve itself and in the adjoining block of native vegetation on private property (Fig. 3) were included. The area in the south is referred to for convenience as 'dunes' (Fig. 2) while, strictly, it is made up of beach ridges (Seddon 1974). The more or less parallel dunes are between 1 and 8 m high above the adjacent swales; most are about 2 m high. The soil parent material is calcareous throughout. North of the dunes there is an abrupt change to the older, more leached sands of the sand sheet (Fig. 2). No calcareous sand was found in this area. Most of the sand sheet is very flat, with elevation from 3 m to 6 m above sea level but reaching 17 m above sea level in one small area. It is possible that the dunes and the sand sheet are of Recent and Pleistocene ages respectively.

The reserve contains a variety of other deposits, but these and the swamps within the sand area were not considered in detail in this study.

BIOTIC INFLUENCES AND DISTURBANCE

Major mammalian herbivores at present include the grey kangaroo (*Macropus giganteus*), the black-tailed wallaby (*Wallabia bicolor*) and the introduced rabbit (*Oryctolagus cuniculus*). Previously, cattle were grazed, especially in the north-west of the area (J. Wilson, Crib Point, Victoria, personal communication) and horses grazed the entire area in the 1930s (T. Hope-Campbell, Somers, Victoria, personal communication).

Valuable data on clearing and fire are available from the air photos of 1939, 1948, 1950, 1957, 1966, 1968, 1970 and 1973 (see also Pl. 1). The 1939 air photos show that a large part of the dunes carried only very scattered trees, certainly less than 25% of those now present. While this low tree density may possibly be due to partial clearing in the 1930s (Wilson, personal communication), the pre-1939 history is almost unknown. Fire, clearing and grazing may all be involved, but for convenience the area is mapped as 'pre-1939 clearing' in Fig. 3. Parts of an old fence were found along the exact southern margin of this 'pre-1939 clearing' area, adding weight to the suggestions of both partial clearing and grazing.

In about 1941 a large part of the sand sheet was completely cleared of trees for an air-strip; tree stumps were left, and it was not graded (Hope-Campbell, personal communication; 1948 air photos; Fig. 3).

Fire history prior to 1939 is not known. The 1939 air photos show some indistinct fire boundaries on the sand sheet. A large fire burnt almost the whole dune area in 1942 or 1943 (Hope-Campbell, personal communication; 1948 air photos) and is referred to here as the 1942 fire (Fig. 3). Many trees in the burnt area survived. Since, there have been only a few very small spot fires. It is important to note that a substantial area of dunes in the west has not been burnt or cleared at least since 1939.

At present, naval and military training operations are conducted in the area, but without serious damage to the vegetation. However, in some areas vegetation is destroyed by topsoil removal operations (Fig. 3).

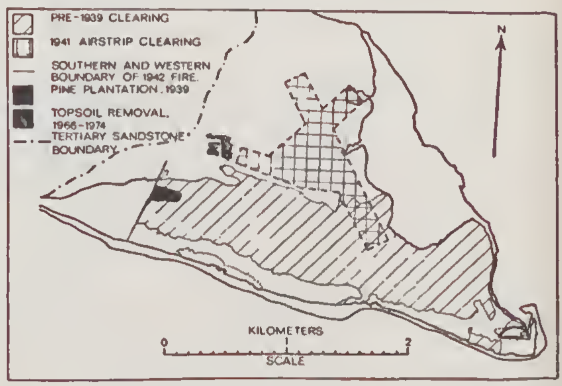

Fig. 3—Fire and clearing boundaries at Sandy Point. 1942 fire burnt most of the dune area down to the dotted lines shown. Unburnt, uncleared, triangular area in west is native vegetation on private property. Lines around coast show littoral zone.

SAMPLING

A detailed study of soils and vegetation was made in a central section of the reserve (Fig. 2) by stratified systematic unaligned sampling (Berry & Baker 1968) of one random quadrat per grid square in a 100 m x 100 m grid (50 quadrats in all). This is a 'restricted randomization' sampling procedure. Five quadrats fell in swamp or recently disturbed areas and were rejected. Two extra quadrats, 51 and 52, were done just north of the main study area to include uncleared *Eucalyptus viminalis* woodland on the sand sheet.

This study area sampled all the major coastal sand communities at Sandy Point except for the pure *E. viminalis* woodland on dunes found in the east. Although the whole reserve was not quantitatively sampled, for the convenience of future workers major vegetation boundaries over the whole reserve were mapped (Fig. 5).

SOILS

In each quadrat soil profiles were examined by augering to a depth of 2 m where practicable. Soil pH was determined in the field (CSIRO soil pH test kit) and the laboratory (Piper 1944) and the presence of $CaCO_3$ by addition of 1 M HCl.

The dune profiles are undifferentiated calcareous sands throughout (Uc 1.11 primary profile form, Table 1) for about 150 m inland from the coast. After that, non-calcareous surface horizons occurred. On the landward dunes Uc 4.21 soils occurred (Table 1), being separated from the Uc 1.11 soils by some rather indeterminate ones intermediate between these two principal profile forms. Such intermediate soils, with non-calcareous topsoils but little other profile development, are referred to hereafter as transitional soils. All the dune soils examined were

TABLE 1
SOIL PROFILE DESCRIPTIONS
(Representative examples of the three main soil groups)

Depth (cm)	Horizon	Description*	Laboratory pH	Presence of $CaCO_3$
1. Uc 1.11 soil. Leptospermum laevigatum open-scrub				
0 - 8	A_1	Dark brown sand	8.1	+
8 - 60	C	Brown sand	8.6	+
60 - 92	C	Yellowish brown sand	8.1	+
2. Uc 4.21 soil. Banksia integrifolia woodland				
0 - 10	A_1	Dark brown sand	5.8	-
10 - 35	A_2	Brown to yellowish brown sand	6.2	-
35 - 40	B	Brownish yellow sand	6.6	-
40 - 55	C	Yellowish brown sand	8.5	+
3. Uc 2.33 soil. Leptospermum juniperinum heath				
0 - 8	A_1	Very dark gray sand with organic matter	4.5	-
8 - 85	A_2	Light gray sand	4.4	-
85 - 90	B	Dark reddish brown hardpan mottled with yellowish red	4.3	-

* All soil colours as Munsell colours on moist sample

underlain by non-coherent calcareous sand; no calcareous hardpans were observed.

The soils of the sand sheet were non-calcareous and acidic throughout, with sandy horizons over humus and iron oxide hardpans (Uc 2.33 primary profile form, Table 1).

In general terms, in moving inland from the coast in such coastal sand country, we expect age of deposit and degree of leaching to increase, causing soil pH, $CaCO^3$ content and general soil fertility to decrease (Bird 1965, Burges & Drover 1953, Turner, Carr & Bird 1961), and this is the pattern found here. Detailed studies in areas of similar climate and soil parent materials suggest that total soil phosphorus declines with increasing age of deposit and decreasing $CaCO_3$ content (Dimmock 1957, Parsons 1966, Parsons & Specht 1957). However, the high alkalinity of the young $CaCO_3$ and phosphorus rich dunes can cause serious lime-chlorosis problems for a number of native plant species (McCoy & Parsons 1974, Parsons & Specht 1967).

In well-drained sandy soils in the climate of the present study area, soil chloride levels are almost certainly negligible, as reported from similar areas (Dimmock 1957).

Throughout the period of the study, no water-tables were encountered in any of the soil holes.

VEGETATION

In circular quadrats of 4 m radius (which consistently sampled more than 80% of the species present in a stand) located as described previously, cover of all vascular plant species was subjectively estimated to the nearest 10% (cover as gross canopy coverage, Daubenmire 1968). As an initial analysis of rather heterogeneous data, the polythetic agglomerative analysis, HGROUP (Veldmann 1967; also called Ward's Method) was used (Fig. 4).

All quadrats dominated by *Leptospermum laevigatum* are grouped together and divided (with two exceptions) into immature stands (Group 1 in Fig. 4) and mature ones not burnt in 1942 (Group 2; Table 2). Nearly all the sand sheet quadrats are grouped and divided into *L. juniperinum-L. myrsinoides* heath (Group 3) and *Eucalyptus viminalis* woodland plus one heath quadrat (Group 4; Table 2). Although the *E. viminalis* woodland described from Uc 2·33 soils in Table 2 is from an area not cleared in 1941, *E. viminalis* woodland does also occur at present on the cleared area.

Finally, the remaining dune quadrats are grouped and divided into

(1) *Banksia integrifolia* open-forest, lacking *E. viminalis* and with *B. integrifolia* cover values greater than 60% (Group 5).

(2) *B. integrifolia* woodland, *B. integrifolia* cover values less than 60%, lacking *E. viminalis*, cover values for *Pteridium esculentum* greater than 90% and for *Scutellaria humilis* from 0 to 50% (Group 6).

(3) As for Group 6, but sometimes with sparse *E. viminalis*, cover values for *P. esculentum* from 10-90% and for *S. humilis* greater than 80% (Group 8).

Groups 5, 6 and 8 form a complex mosaic on the landward dunes which could not be accurately mapped, even at large scales. If grouped

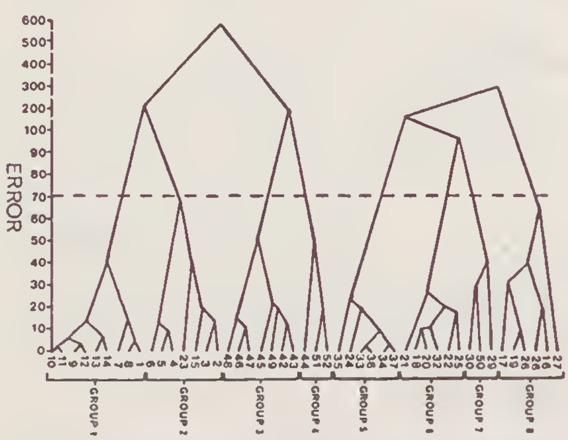

FIG. 4—Dendrogram from HGROUP classification of quantitative vegetation data (cover values). Note change of scale at 100 error units. Error scale gives measure of within-group diversity.

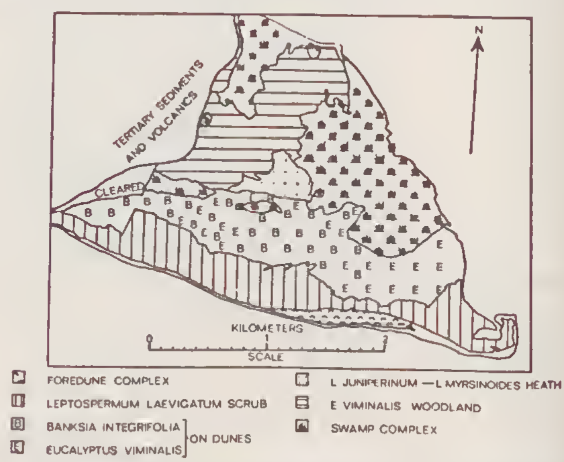

FIG. 5—Major vegetation boundaries in Sandy Point Naval Reserve in 1973 (from air photos). *Banksia integrifolia—Eucalyptus viminalis* on dunes refers to woodland.

TABLE 2
PLANT COMMUNITY DESCRIPTIONS
UD = undestory dominant. 'Differential species' used in the sense of Bridgewater (1971).

Group and its differential species	Sub-group and its differential species	Other common species	Edaphic range	Soil pH*	Notes
Leptospermum laevigatum (*L. laevigatum*, *Senecio lautus*)	*L. laevigatum* open-scrub (*Acacia sophorae*, *Cotula australis*)	*Scirpus nodosus*	Uc 1.11	8.1 - 8.2	Unburnt in 1942
	L. laevigatum closed-scrub (*Centaurium pulchellum*, *Caladenia latifolia*)	*Clematis microphylla* *Leucopogon parviflorus*	Uc 1.11 and transitional	6.5 - 8.0	Burnt in 1942
Banksia integrifolia (*Geranium solanderi*, *Scutellaria humilis*)	*B. integrifolia* woodland (none)	*L. parviflorus* *Pteridium esculentum* UD	Transitional and Uc 4.21	5.8 - 6.5	
	B. integrifolia open-forest (none)	*C. microphylla* *P. esculentum* UD	Transitional and Uc 4.21	5.8 - 6.5	*Banksia* regeneration from 1942 fire
L. juniperinum (*L. juniperinum*, *L. myrsinoides*)	*L. juniperinum* - *L. myrsinoides* closed-heath (*Aotus ericoides*, *Epacris impressa*)	*Amperea xiphoclada* *Monotoca scoparia*	Uc 2.33	4.0 - 4.5	Cleared in 1941
	Eucalyptus viminalis woodland (*Gahnia radula*)	*L. juniperinum* UD *Lepidosperma concavum*	Uc 2.33	4.4	Not cleared

* Laboratory pH of surface soil

as one unit, this and all the other communities recognized by HGROUP are usually recognizable on air photos and so were used to construct a vegetation map (Fig. 5). Groups 6 and 8 have been combined on Table 2.

Group 7 is a heterogeneous, ecotonal group of one landward dune quadrat and two seaward sand sheet quadrats all with *E. viminalis* dominant and high *P. esculentum* values (Fig. 4).

Foredunes were absent from the study area, having been removed by wave action. At Sandy Point itself they carry *Ammophila arenaria-Spinifex hirsutus* open-grassland with *Cotula australis.* Moving inland, this community is replaced by low shrubs of *Acacia sophorae* and *Leptospermum laevigatum* and then by *L. laevigatum* open-scrub as is found behind the beach in the main study area.

The *L. laevigatum* dominates either an open-scrub or closed-scrub depending on time since burning (Table 2, Pl. 15). To landward, this is replaced by woodlands usually dominated by *Banksia integrifolia*, but sometimes with *Eucalyptus viminalis* dominant or co-dominant. It is hard to know to what extent differential clearing has determined these differences in tree dominance. Scattered young stands of *B. integrifolia* (seedling regeneration from the 1942 fire) have low open-forest structure (Table 2).

A floristically similar dune sequence has been described from Corner Inlet (Turner, Carr & Bird 1962). The factors determining these zonations are not well understood. Particularly at the seaward edge, instability of sand and exposure to wind and salt-spray are likely to be important. To landward, soil effects may become significant. For example, at Sandy Point *E. viminalis* is absent from sands which are calcareous right to the surface. Work elsewhere shows that, in Victoria, eucalypts are almost completely absent from such calcareous beach sands (except for occasional stands of *E. ovata*), probably because they are prone to lime-chlorosis on highly alkaline soils (Parsons & Specht 1967, McCoy & Parsons 1974). In contrast, *B. integrifolia* is common on calcareous beach sands elsewhere (Parsons 1966).

The relative distribution of *L. laevigatum* and *B. integrifolia* may depend not only on differential tolerance to factors like salt spray, but also on fire effects. The *L. laevigatum* closed-scrub originating from the 1942 fire contains dead *B. integrifolia* trees; these and the air photos suggest that *L. laevigatum* has spread inland at the expense of *B. integrifolia* as a result of the 1942 fire. Throughout the dune area studied, there are no strong vegetation differences between crests and swales.

Further inland, virtually all of that part of the sand sheet adjoining the dunes was cleared for an airstrip in 1941. This regenerated as closed-heath (air photos), but at present some parts are of woodland structure, while in the remainder, scattered trees, especially of *E. viminalis*, are now clearly emergent so that the structure is transitional to woodland (but referred to here as heath for convenience). The sand sheet markedly differs from the dunes both edaphically and floristically (Table 2).

It is clear that all the heath area was formerly *E. viminalis* woodland (1939 air photos) which still occurs adjacent to it in topographically and edaphically similar sites. An unusual feature of the heath area is the presence of some emergent young trees of *Banksia integrifolia*, a species not known from highly leached sands elsewhere (Parsons 1966). This occurrence may relate in some way to fire or clearing effects, as may the presence of a patch of *Leptospermum laevigatum*.

In moving from the dunes to the sand sheet, species like *Scutellaria humilis*, *Leucopogon parviflorus* and *Galium australe* drop out entirely and species exclusive to the sand sheet like *Leptospermum juniperinum*, *L. myrsinoides* and *Epacris impressa* become common. This marked change in floristics is likely to be caused at least partly by the greater infertility of the more strongly leached and more acidic sand sheet.

DISCUSSION

Geologically, the area has potential for chronosequence studies of plant succession on coastal sand like those of Burges and Drover (1953) and Olson (1958), as it has up to 18 parallel dunes almost certainly representing a time sequence and showing corresponding progressive changes in soil development. However, the time sequence of vegetation has been badly disrupted by differing histories of both fire and clearing which would make reliable detailed interpretation impossible. The soil development chronosequence appears intact and is certainly worth further study.

Clearly, there is a sharp discontinuity in age and corresponding soil properties from the dunes to the older, more strongly leached and more acidic sand sheet, and this corresponds exactly to the normal distinction between 'New Dunes' and 'Old Dunes' (and sand sheets) made elsewhere in southern Australia (Bird 1965, Parsons 1966, Turner, Carr & Bird 1962).

Considering the probable successional sequence on the 'New Dunes', the vegetation zones described here are broadly similar to those elsewhere in Victoria (Parsons 1966, Turner, Carr & Bird 1962). The precise successional relationships between *Banksia integrifolia* and *Eucalyptus viminalis* are not clear from these studies or the present one (because of fire and clearing effects). All that can be said is that the apparent dune climax at Sandy Point is a woodland in which either *B. integrifolia* or *E. viminalis* or both are dominants. Considering a longer time scale, it could be argued that continued leaching over long periods will convert the dune soils into the highly acidic type found on the sand sheet. In this case, the long term 'climax' would be *E. viminalis* woodland with a sclerophyllous under-storey.

A major finding of the work is that the whole reserve has suffered much more from human disturbance than has previously been thought. Clearing has modified about half of the total sand sheet area and about two-thirds of the dune area. Although there has obviously been a lot of tree regeneration since the 1939 air photos, it is not known to what extent this has reproduced the original proportions, distribution and density of tree species. Further, clearing is likely to have contributed very greatly to the high density of *Pteridium esculentum* in most of the *Banksia integrifolia* and *Eucalyptus viminalis* communities on the dunes, and this increase in *P. esculentum* may have had major effects on other understorey species. It is significant that *P. esculentum* density where such communities are unburnt and uncleared in the west is generally much lower than in the cleared areas. Such clearing effects need to be carefully borne in mind in future biological work, both in comparisons within the reserve and in extrapolation to other areas. Also, they help to explain the floristically atypical nature of the heath at Sandy Point noted by Calder (1972).

The present study makes this reserve one of the very few (perhaps the only) areas of coastal vegetation in Victoria with a reasonably well-documented fire and clearing history. As such, and because there is a sizeable area of vegetation on private property in the west apparently never cleared and not burnt since before 1939, the area would be highly suitable for studies of the effect of fire on the regeneration of *Leptospermum laevigatum*, *Banksia integrifolia* and *Eucalyptus viminalis* communities, by comparing the nature and age structure of existing stands. Such considerations, along with the size of the area, its proximity to Melbourne and its diversity of animal species (Ahern 1974, Davis & Reid 1974) make it an invaluable biological resource.

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Appendix 1 (pages 91-94)

Vascular plant species recorded from sand dunes and sand sheets at Sandy Point Naval Reserve and adjoining private property (see text). c = common, f = frequent, r = rare.

1 = *Leptospermum laevigatum* scrub on dunes, 2 = *Banksia integrifolia* + *Eucalyptus viminalis* woodland and forest on dunes, 3 = *L. juniperinum-L. myrsinoides* heath on sand sheet, 4 = *E. viminalis* woodland on sand sheet, 5 = *Poa labillardieri* grassland on low-lying sand area with restricted drainage (see Fig. 2). * = alien species. *Daucus glochidiatus,* also present in 1 and 2, is not included.

APPENDIX 1

	1	2	3	4	5
PTERIDOPHYTA					
ASPIDIACEAE					
Polystichum proliferum		r			
ASPLENIACEAE					
Asplenium flabellifolium		r			
DENNSTAEDTIACEAE					
Pteridium esculentum	r	c	c	f	
POLYPODIACEAE					
Microsorium diversifolium		r			
SELAGINELLACEAE					
Selaginella uliginosa			r		
GYMNOSPERMAE					
PINACEAE					
**Pinus radiata*		r			
MONOCOTYLEDONEAE					
ARACEAE					
**Zantedeschia aethiopica*		r			
CYPERACEAE					
Baumea juncea					f
Gahnia radula				f	
Lepidosperma concavum		c	f	c	
L. gladiatum	r	r			
Scirpus antarcticus		r			
S. nodosus	c	c	r	r	
IRIDACEAE					
**Homeria breyniana*		r			
CENTROLEPIDACEAE					
Centrolepis strigosa		r			
JUNCACEAE					
Juncus pallidus		f			f
J. vaginatus					f
Luzula meridionalis Nordenskiold	r	r	r		

	1	2	3	4	5
LILIACEAE					
**Asparagus asparagoides*		r			
Dianella revoluta		r	r		
Lomandra longifolia		r			r
ORCHIDACEAE					
Acianthus exsertus	r	r			
A. reniformis	f	f			
Caladenia latifolia	f				
Corybas diemenicus		r			
Dipodium punctatum		r		r	
Microtis unifolia		r			
Pterostylis longifolia		r		r	
POACEAE					
**Agropyron juncea*	Foredunes				
A. scabrum		f			
**Aira caryophyllea*		f		f	
Agrostis avenacea		f		f	f
**A. tenuis*		r			
**Ammophila arenaria*	Foredunes				
**Anthoxanthum odoratum*		r			
**Briza minor*		r		r	
**Bromus* sp.		r			
**Catapodium rigidum*	f				
Danthonia pilosa		f			
D. setacea		f		f	
Dichelachne crinita		c		c	
Distichlis distichophylla	r				r
Echinopogon ovatus		c			
Hemarthria uncinata					c
**Holcus lanatus*	f	f			f
Imperata cylindrica		f			
**Lagurus ovatus*	f	f			
Microlaena stipoides		r			

APPENDIX 1 (*continued*)

	1	2	3	4	5
EPACRIDACEAE					
Epacris impressa			c	r	
Leucopogon parviflorus	c	c			
L. virgatus			f	r	
Monotoca scoparia		c	r		
EUPHORBIACEAE					
Amperea xiphoclada			f	r	
Poranthera microphylla		r			
FABACEAE					
Aotus ericoides			c	f	
Bossiaea cinerea			r		
B. prostrata				r	
Dillwynia glaberrima			f		
Glycine clandestina	r	r			r
Indigofera australis		r			
Kennedia prostrata		r			
**Trifolium* sp.		r			
**T. dubium*		r			
**Ulex europaeus*		r			
GENTIANACEAE					
**Centaurium pulchellum*	f	f			f
GERANIACEAE					
Geranium solanderi	f	f			f
HALORAGACEAE					
Haloragis tetragyna			f	f	
HYPERICACEAE					
Hypericum gramineum			r		
LAMIACEAE					
Mentha diemenica var. *serpyllifolia*					r
Scutellaria humilis		c			

	1	2	3	4	5
LAURACEAE					
Cassytha glabella			r		
LORANTHACEAE					
Amyema pendula		r			
MIMOSACEAE					
Acacia armata		r			
Acacia longifolia var. *sophorae*	c	f			
A. melanoxylon		r			
**A. saligna*		r			
MYRTACEAE					
Eucalyptus viminalis var. *racemosa*		f	r	c	
Leptospermum juniperinum			c	c	
L. laevigatum	c	f	r		
L. myrsinoides			c	f	
Melaleuca ericifolia					f
M. squarrosa			r		
OXALIDACEAE					
Oxalis corniculata		f			f
PHYTOLACCACEAE					
**Phytolacca octandra*		r			
POLYGONACEAE					
**Acetosella vulgaris* Fourr.		r			
Muehlenbeckia adpressa	c				
POLYGALACEAE					
Comesperma volubile		r			
PRIMULACEAE					
**Anagallis arvensis*	c	c			
PROTEACEAE					
Banksia integrifolia	r	c	f		
B. marginata			r	f	

Appendix 1 (*continued*)

	1	2	3	4	5		1	2	3	4	5
**Poa annua*	f	f				*S. lautus*	c	r			
P. labillardieri Steud.		c			c	*S. minimus* x *S. lautus*		r			
P. poiformis	f	r				*S. minimus*		f			r
**Setaria geniculata*		r				*S. quadridentatus*		r			
Spinifex hirsutus	Foredunes					**Sonchus asper*		f			f
**Sporobolus africanus*		f				*S. megalocarpus*	f				
Stipa compacta		c				**S. oleraceus*	r	r			
Themeda australis		f				BORAGINACEAE					
**Vulpia bromoides*	r	r				*Cynoglossum australe*		r			
DICOTYLEDONEAE						*Myosotis australis*	f				
AIZOACEAE						BRASSICACEAE					
Tetragonia implexicoma	f	f				*Cakile maritima*	Foredunes				
APIACEAE						CAMPANULACEAE					
Centella cordifolia		r				*Wahlenbergia quadrifida*		r			
Hydrocotyle foveolata	r					*W. stricta*		r			
ASTERACEAE						CARYOPHYLLACEAE					
Apalochlamys spectabilis	r					**Cerastium glomeratum*	c	f			
**Carduus tenuiflorus*		f			f	*Colobanthus apetalus*	Foredunes				
**Chrysanthemoides monolifera*		r				**Stellaria media*	c	c			
**Cirsium arvense*					r	CHENOPODIACEAE					
**C. vulgare*		f			f	*Rhagodia baccata*	r	r			
**Conyza bonariensis*	c	c	r		c	CONVOLVULACEAE					
Cotula australis	c	r				*Dichondra repens*	c	c			c
Gnaphalium gymnocephalum DC.		r				CRASSULACEAE					
G. sphaericum Willd.	r					*Crassula macrantha*	f	f			
G. luteo album	r	r		r		*C. sieberana*	f				
**Hypochoeris radicata*	r	r			f	DILLENIACEAE					
**Inula graveolens*		r				*Hibbertia acicularis*			r	r	
Lagenophora stipitata	f	f			f	*H. sericea*				r	
**Leontodon taraxicoides*		f			f	DROSERACEAE					
**Onopordum acanthium*		r				*Drosera planchonii*				r	
**Senecio jacobaea*		r			r	*D. whittakeri*			r	r	

APPENDIX 1 (*continued*)

	1	2	3	4	5
RANUNCULACEAE					
Clematis microphylla	c	c	r		
Ranunculus pumilio	r	r			
_R._ sp.		r			
ROSACEAE					
Acaena anserinifolia		r			r
*_Rubus fruticosus_ sp. agg.		r			
RUBIACEAE					
Galium australe	f	f			f
Opercularia varia			r		
SANTALACEAE					
Exocarpos cupressiformis		r			
SCROPHULARIACEAE					
*_Verbascum virgatum_					r
Veronica gracilis					r
*_V. persica_		r			
SOLANACEAE					
Solanum sp.		r			
S. nigrum		r			
URTICACEAE					
Parietaria debilis	f	f			

EXPLANATION OF PLATES 14 AND 15

PLATE 14

Upper—Air photo of Sandy Point, 1939. Dark zone along southern coast is _Leptospermum laevigatum_ scrub. Partially cleared zone is immediately inland of this.

Lower—Air photo of Sandy Point, 1968, showing copious tree regeneration in cleared zone since 1939.

PLATE 15

Top left—Leptospermum laevigatum scrub burnt in 1942.

Top right—Banksia integrifolia woodland with _Lepidosperma gladiatum_ dominant in the understorey.

Bottom left—Leptospermum laevigatum scrub which regenerated after 1942 fire.

Bottom right—L. juniperinum-L. myrsinoides heath in foreground; trees of _Eucalyptus viminalis_ and _Banksia integrifolia_ in background.